IDAHO BLM

TECHNICAL BULLETIN

AN ANNOTATED BIBLIOGRAPHY ON THE

INTERRELATIONSHIP OF ELK AND ROADS

by

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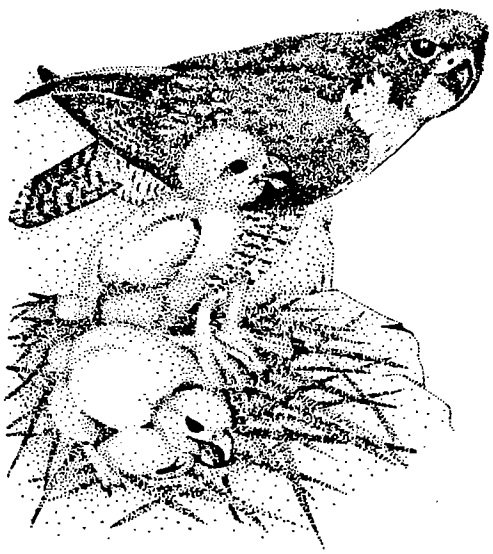

Technical Bulletin 89-2

January 1989

BUREAU OF LAND MANAGEMENT
IDAHO STATE OFFICE
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INTERRELATIONSHIP OF ELK AND ROADS

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Introduction

Beginning in the 1960s, accelerated timber harvest coupled with increased hunting pressures brought about conflict over the management of elk habitat. In response to these pressures, numerous research efforts were initiated by the game departments and various federal agencies in several states. These studies spanned the years from the early 1970s through the mid 1980s.

The purpose of this bibliography is to gather together citations from most of the literature that deals with the impacts of roads on elk and elk habitat. It is not an exhaustive effort since many reports, especially the earliest ones are no longer available. This information is intended as a guide to the most available and comprehensive of the material that was written on the subject. The references listed in this bibliography are on file in the BLM's Denver Service Center library. Many are also available from the BLM Idaho State Office library.

Where possible summaries of the information is given using the author's abstract. In cases where the abstract was excessively long the most pertinent text was excerpted. In some cases, an abstract was not available, and we summarized the information.

Although abstracts are useful in getting at the gist of the original text, they should not be substituted for the text.

References

Anonymous. 1978. Elk-roads-logging relationships, a current resume of findings. U.S.D.A. Forest Service. Intermountain Region.

The objective of this paper is to provide a state-of-the-art literature review of elk and logging management with particular reference to the Intermountain area. Results from the review indicate a mixed bag of impacts on elk from logging activities. References reviewed and discussed include: increased forage production following timber harvest, effects of roads on elk, forest management practices, and general wildlife considerations.

Basile, J.V. and T.M. Lonner. 1979. Vehicle restriction influence elk and hunter distribution in Montana. Journal of Forestry. 77(3), pp. 155-159.

Restricting vehicle use on portions of two areas in Montana led to contrasting results in overall hunting pressure, in seasonal distribution of hunters and of elk, and in elk harvest. The Judith River area of the Lewis and Clark National Forest was two-thirds forested with interspersed clearcuts and natural openings; here hunting pressure increased 26 percent, but distribution through the seasons was unchanged. Conversely, on the Ruby River area of the Beaverhead National Forest, essentially open grassland with scattered islands of timber, overall hunting pressure did not change significantly, but was more uniformly distributed through the seasons when travel was restricted. The numbers of elk seen and killed per hunter each increased 28 percent under vehicle restrictions on the Judith River area. However, the uniformity of sightings and kills through the seasons increased markedly on the Ruby but not on the Judith. Differing responses were believed due mostly to differences in total forest cover on the two areas. Hunters spent more time walking, and consequently saw more elk under restricted travel conditions than under unrestricted travel. (Author's abstract)

Beall, R.C. 1976. Elk habitat selection in relation to thermal radiation. In: Proceedings, Elk-logging-roads symposium. University of Idaho, Moscow, ID. pp. 97-100.

Elk react to changing ambient air temperature and solar and thermal radiation conditions by selecting bedding sites which enhance control of body temperature. As air temperature increased, elk beds shifted sequentially to north slopes during the day and south slopes at night. The number of trees per acre in selected day bed sites also decreased. In all cases of habitat selection under varying meteorological conditions a closer correlation was found with thermal and solar radiation intensities than with ambient air temperatures. (Author's abstract)

Brekke, E.B. 1988. Using GIS to determine the effects of CO2 development on elk calving in south-central Colorado. Tech. Note 381. U.S.D.I. Bureau of Land Management. Denver Science Center. pp. 36.

The ARCO Oil and Gas Company funded a study to determine the impacts of full-scale drilling activities on elk calving and to record elk responses to associated human disturbances such as use of roads in the calving area. Findings indicated the CO2 development project caused a significant shift in elk distribution around the drill sites located within the calving areas. Management recommendations included; develop roads and other facilities in shortest possible time, place them in areas least used by elk, place them in sites that are less visible to elk, and maintain security cover adjacent to roads and drill sites.

Bright, L.R. 1981. Elk habitat inventory and mapping utilizing LANDSAT Satellite data. Wildlife Research Report No. 11, Oregon Department of Fish and Wildlife, Portland, OR. 33 pp.

LANDSAT imagery was used to inventory and map approximately 260,000 ac. of Rocky Mountain Elk habitat within the Heppner Wildlife Management Unit, Morrow County, Oregon. Habitat components such as thermal cover, hiding cover, and forage areas as well as mileage for three classes of roads were mapped. The total potential elk use was calculated for the Wilson TRI - compartment as an example of how to use cover and forage data, roading impacts, and size/spacing information. (Excerpted author's abstract).

Brown, C. 1985. Sand Creek elk. Job completion Report. Project No. W-160-R. Idaho Department of Fish and Game. 119 pp.

An interagency study of elk movements and habitat uses from the period of January 1981 to May 1985. One section documents the avoidance of Highway 33 in the winter range. Area affected by the traffic use on the road was documented out to 1500 m.

Burbridge, W.R., and D.J. Neff. 1976. Coconino National Forest-Arizona Game and Fish Department cooperative roads - wildlife study. In: Proceedings, Elk-logging-roads symposium. University of Idaho, Moscow, ID. pp. 44-57.

Big game use and hunter use and success are being studied on two adjoining areas of the Coconino National Forest. One area is annually closed to motorized vehicles. Weather appears to be the major influence on big game distribution; however, cattle grazing also has an influence. A "refuge effect" has not been observed in the area closed to motor vehicles.

Information on the intensity and seasonality of motor vehicle travel has been gathered in the study area. The level of vehicle travel in the spring and summer, during the big game reproductive periods, is light and probably insignificant in impact. In the fall, when traffic is heavier, the closed area offers no refuge because a considerable number of hunters are active on foot. Hunters will support small area road closures, although deer and especially elk hunters are concerned with game retrieval. The road closure has not significantly altered deer and elk hunter use or access in the study area. There appears to

have been a slight decline in turkey hunters in the closed area, traceable to the fact that many fall turkey hunters are road hunters.

Collins, W.B., P.J. Urness, and D.D. Austin. 1978. Elk diets and activities on different lodgepole pine habitat segments. Journal of Wildlife Management. 42(4). 799-810.

The biweekly diets of tame elk (Cervus canadensis) were established on a species dry-weight basis for different habitat segments in the lodgepole pine (Pinus contorta) type. Principal species in the diets (those comprising 5% or more) on each habitat segment were generally composed of preferred species. However, some highly abundant but nonpreferred species took on principal dietary status, whereas some preferred species, scarce in the vegetation, contributed less than 5 percent to diets. Forbs contributed most to total diet; grasses and sedges were the second largest contributors. Browse appeared to be of limited importance, but mushrooms had special significance in forested habitat segments. Preference changes were evident as forb species matured. Consumption rates were significantly higher in habitat segments having greater species diversity and forage density. The time tame elk spent grazing, ruminating, lying, grooming, traveling, standing, drinking, and playing was referenced to specific habitat segments in which each activity occurred. One thousand and eight hours of individual elk activity were observed over a series of 6 24-hour periods. Wet meadows, dry meadows, clearcuts, and revegetated roads were preferred as grazing sites, while mature and stagnated forests were clearly nonpreferred. Wet meadows, revegetated roads, and mature forest were preferred for resting and nongrazing activities. (Author's abstract)

Devlin, D.A. and J.L. George. 1979. Forage utilization by elk and white-tailed deer on two clearcuts in Elk County, Pennsylvania. In: North American elk: ecology, behavior and management. Boyce, M.S. and Hayden-Wing, L.D. eds. University of Wyoming. Laramie, Wyoming. pp. 98-104.

Randomly placed exclusion cages were used to determine biomass utilization of volunteer (naturally occurring) vegetation on clearcuts and seeded plants on access and logging roads by using the clipped dry weight differences between caged and uncaged samples. Results indicate that both elk and white-tailed deer used the seeded roads in spring, whereas in the early fall, elk were the primary users of these areas. Utilization of volunteer vegetation was found to be significant in summer due to the heavy use of blackberry by both elk and white-tailed deer. Utilization of volunteer forage species was determined using the differences in species densities from caged and uncaged areas. Significant differences in species densities were noted for blackberry and woody stems. Using these data, several management implications are suggested.

Edge, D.W. and C.L. Marcum. 1985. Movements of elk in relation to logging disturbances. Journal of Wildlife Management. 49(4):926-930.

Elk (Cervus elaphus) movement in relation to logging activities were studied in Chamberlain Creek, Montana, between 12 August and 30 September 1981. Fifty-six aerial and 61 ground telemetry locations were obtained for nine cow elk. Normal elk movements in the Chamberlain Creek area were short and probably related to forage availability. Movements away from disturbance were significantly longer than those toward disturbance, but the sequence of movements was random with respect to source of disturbance. Elk tended to move into areas of logging activity on weekends during non-active periods, but habituated to the disturbance. A buffer zone of 500-1,000 m separated areas of high elk use from areas of disturbance. Habituation may decrease this buffer zone. This displacement of elk may cause substantial reduction in habitat availability. (Author's Abstract)

Edge, D.W., C.L. Marcum, S.L.O. Edge. 1987. Summer habitat selection by elk in Western Montana: A Multivarinte Approach. J. Wildlife Manage. 51(4): 844-851.

A study to identify the important components of elk (Cervus elaphus) habitat, through discriminant comparisons of elk-selected and random habitat samples, was conducted between mid-June and mid-October 1982 and 1983. Seventeen variables were measured from aerial photographs, maps, or in 375-m2 plots for 354 radio-monitored and 172 random locations. Stepwise discriminant analysis was used to test the hypothesis of equal mean vectors between monthly elk locations and random sites. Elk locations differed between months and from random locations ($P<0.01$). The most important variables were slope, the amount of foraging area within 200 m of each location, and distance to open roads and human disturbance Site-specific habitat characteristics were not apparent in the data because elk made broad use of available habitats. Summer-long habitat for elk can be evaluated from maps and aerial photographs. (Author's Abstract)

Geist, V. 1978. Behavior. pp. 283-296. In: Big Game of North America, Schmidt, J.L., and D.C. Gilbert, eds. Stackpole Books. Harrisburg, P.A.

Geist's chapter includes those aspects of animal behavior that aid the big game manager in reaching their management goals. Harassment of big game is singled out for somewhat more detailed discussions. Three conclusions Geist draws when dealing with big game management problems and animal behavior are: 1) knowledge of the behavior and biology of local populations is necessary; 2) generalizations are warranted only when and where great care is exercised; and 3) verification of assumptions is most desirable.

Gillin, C.M., and L.L. Irwin. 1985. Response of elk to seismograph exploration in the Bridger-Teton National Forest, Wyoming. University of Wyoming, Department of Zoology and Physiology. 53 pp.

This study documented displacement of radio-collared elk within their home ranges by an average of 3/4 mile. This was especially true for elk on calving ranges and on alpine summer ranges. Elk tended to move out of open areas into dense forest types and more secluded areas away from roads. These areas were usually areas of lower forage production.

Grossarth, O.D. 1981. Elk-timber relationships of west-central Idaho. Idaho Department of Fish and Game/Bureau of Land Management/U.S. Forest Service. 37 pp.

This paper provides land managers on the Boise and Payette Forests a means to assess and evaluate the affects of silvicultural practices, timber harvest techniques and other land management actions on elk and their habitat.

Grover, K.E. and M.J. Thompson. 1986. Factors influencing spring feeding site selection by elk in the Elkhorn Mountains, Montana. Journal of Wildlife Management. 50(3): 466-470.

Elk (Cervus elaphus) spring feeding site selection as influenced by 12 environmental variables was investigated in the Elkhorn Mountains of southwestern Montana during 1983-84. Variables included cattle use, plant community descriptions, distance to disturbance sources, and topographic descriptors. In multiple regression we were able to account for 68% of the variation in elk spring feeding site selection. Elk selected feeding sites that were previously grazed by cattle and supported relatively high densities of bunchgrass plants. Elk made the greatest use of these sites when they were located near cover and away from visible roads. (Author's abstract)

Gruell, G.E. and G. Roby. 1976. Elk habitat relationships before logging on Bridger-Teton National Forest, Wyoming. In: Proc. Elk-logging-roads symp., University of Idaho, Moscow, Id. pp. 110-121.

Telemetered elk data and time-lapse photography showed that infrequently used four-wheel drive roads had minimal impact on elk during the summer. During hunting season, elk avoided localities where the roads were used.

Hayden-Wing, L.D. 1979. Distribution of deer, elk, and moose on a winter range in southeastern Idaho. pp. 122-131. In: North American Elk: ecology, behavior and management. Boyce, M.S., and Hayden-Wing, L.D., eds. University of Wyoming, Laramie, WY 294 pp.

The distribution of mule deer (Odocoileus hemionus hemionus), Rocky Mountain elk (Cervus canadensis nelsoni), and Yellowstone moose (Alces alces shirasi) was studied on a winter range of stabilized dune sand in Freemont County, Idaho during the winter of 1961-62. Both visual observations and pellet group counts indicated very little overlap in the areas used by these three species. Deep snow evidently restricted deer distribution to the few south-facing slopes on the area. The available browse on these slopes reflected the cumulative impact of years of intensive winter deer concentrations and was less vigorous than elsewhere. Elk distribution appeared to be influenced primarily

by man's activities and secondarily by snow depths and vigor of browse. Within those portions of the winter range farthest removed from human activities, elk concentrated on areas of moderate snow depth where good browse forage was available. The distribution of moose was apparently affected most by the vigor and distribution of chokeberry (Prunus virginia var. demissa) on the range. Moose consistently sought out the largest, most vigorous stands of chokecherry and did not appear to be affected by either man's activities or snow depths that excluded deer and elk.

Hershey, T.J., and T.A. Leege. 1976. Influences of logging on summer range in north central Idaho. In: Proceedings, Elk-logging-roads symposium. University of Idaho, Moscow, ID. pp. 73-80.

A study of elk distribution, movements and habitat selection with respect to clearcuts, roads and human disturbance was conducted on summer range in north-central Idaho in 1974 and 1975. Elk avoided using areas within 0.4 km (0.25 miles) of primary and secondary roads and showed a high preference for areas farther than 0.4 km from a road. Elk were located closer to roads in November than in any other month. Opening of the general elk season in October did not influence elk distribution with respect to mean distance from nearest primary and secondary roads. The distribution of radio fixes on two cow elk and 25 hunter kills within 3.2 km (2 miles) of three active cutting units indicated elk did not move away from low intensity, short-term logging disturbance. (Excerpted author's abstract.)

Hershey, T.J., and T.A. Leege. 1982. Elk movements and habitat use on a managed forest in north-central Idaho. Wildlife Bulletin No. 10, Idaho Department of Fish and Game. 24 pp.

Seasonal elk movements, distribution and habitat preferences were investigated on a managed forest in north-central Idaho from June 1974 through August 1977. Ground and aerial surveys provided 289 visual sightings of 1,088 marked and unmarked elk, and radio telemetry provided 900 relocations of 9 radio-collared elk. We estimated that about 300 elk summered on the study area. The observed cow:calf:bull ratio averaged 100:52:19 during the study.

Old-growth grand fir associated with poorly drained, cool, moist land types were important habitat features during late summer and early fall. Clearcuts received greatest use in spring, early summer and late fall. When using clearcuts, elk selected areas where slash was removed by broadcast burning, and areas within 92 m of timber.

Disturbance from human activity was an important factor influencing elk distribution in our study. We observed displacement of elk from hunting, logging and motor vehicles. Degree of displacement appeared to be related to proximity, intensity and duration of disturbance.

Access roads for timber harvest strongly influenced elk hunter and harvest distribution. A greater harvest rate was evident for animals within 800 m of a road. Results from a questionnaire indicated that many sportsmen favored road closures. (Excerpted author's abstract.)

Hieb, Susan R. 1975. Proceedings of the Elk, Logging, Roads Symposium, Moscow, Idaho, December 16-17, 1975. University of Idaho. 142 p.

Contains 18 papers dealing with the impact of logging and road use on elk.

Houston, D.B. 1982. The Northern Yellowstone Elk, Ecology and Management. McMillan Publishing Co., New York, NY, pp. 474.

This reference summarizes elk ecology and management in a setting where less than 0.3% of their northern winter range is affected by human developments including roads. It discusses habitat preference and utilization levels. The references also gives an example of how susceptible wintering elk are in roaded areas where hunting is permitted, i.e. 1283 hunters took 1,121 elk in 1976. This pressure significantly altered the movement of the animals out of the parks onto their wintering area.

Irwin, L.L. and J.M. Peek. 1979. Relationship between road closures and elk behavior in northern Idaho. In: North American elk: ecology, behavior and management. University of Wyoming. Laramie, Wyoming. pp. 199-204.

From 1975 through 1977 a radio-tracking study of elk (Cervus elaphus) habitat use patterns in relation to forest management, hunters, and roads was conducted in western hemlock (Tsuga heterophylla) and grand fir (Abies grandis) forest in northern Idaho. Half of the study area was in various stages of secondary succession following a 1931 wildfire; the remainder was old-growth western hemlock. Nine elk were monitored: four during 3 successive hunting seasons, one during 2 seasons, and four during 1 season. Vehicular access was unrestricted in 1975, and prohibited from 1 September to 1 November in a 40 km area in 1976 and a 75 km area in 1977. Traffic counters on main roads in 1975 and 1977 indicated total numbers of hunters did not change in the general area. Although six of the radio-collared elk were harvested during the three years, it was undetermined whether or not hunting success changed as a result of the road closures. General areas of use as well as habitat selection by elk within those areas during the hunting season appeared to be governed primarily by previous traditions and social behavior associated with the rut. During each season hunters displaced elk from preferred areas to areas of similar but more extensive habitat. Road closures allowed elk to remain longer within preferred areas. (Excerpted Author's abstract)

Irwin, L.L. and J.M. Peek. 1983. Elk habitat use relative to forest succession in Idaho. Journal of Wildlife Management. 47(3):664-672.

Home range use and habitat selection by a nonmigratory elk (Cervus elaphus) herd in relation to forest succession in the cedar-hemlock (Thuja-Tsuga) zone of northern Idaho were studied through use of radiotelemetry. In spring, elk preferred grass-shrub and seral shrub successional stages for feeding and tall seral brushfields or pole-timber stands for resting. Elk fed in clear-cuts and seral shrub communities in summer and rested primarily within pole-timber stands on ridges. In autumn, elk shifted to pole-timber communities on mesic

slopes. No significant selection patterns occurred on winter range. Elk preferred to rest in areas over 400 m from traveled roads in all seasons. Home ranges contained more foraging area (35 vs. 20%) and less thermal and hiding cover (64 vs. 79%) than present in the study area overall. Selection of home ranges was related to forage production in seral stages of succession. Cover and human disturbance were important in habitat use in autumn. (Author's abstract.)

Kuck, L. 1984. Southeast Idaho wildlife studies (July 1978 to June 30, 1983), Idaho Department of Fish and Game, Job Completion Report W-160-r, 1246 pp.

A major research effort was conducted in the Soda Springs, ID area to document the impacts of phosphate mining on various wildlife species that use the area. The total findings of this study are included in a 1246 page report.

General findings on the impacts of mining development, which included road development, indicated that elk calves disturbed by mining activities move greater distances, used coniferous forest more and readily abandoned their traditional calf-rearing areas. Calf abandonment was not documented. More significant to big game during development of roads was the increased mortality rate caused by poaching. Natural mortality on deer, elk and moose in this areas was 41%, 27% and 14% respectively. Illegal kills in the mining area increased to 47%, 55% and 86% respectively for the same species.

Leckenby, D.A., and A.W. Adams, 1981. Eastern Oregon cover study - interim report. Oregon Department of Fish and Wildlife, Research and Development Section, La Grande, OR. 63 pp.

This paper deals with the interim findings of a long term elk and deer study by the State and Federal land/wildlife management agencies in the Blue Mountain region. One section addressed "Elk Use of Habitat Relative to Human Activity". Interim findings indicated that elk used habitats between 100-800 yards of human activities such as road activity, chopping wood, working on cars, etc. with partial to complete vegetative screens.

Leege, T.A. 1976. Relationship of logging to decline of Pete King elk herd. In: Proceedings, Elk-logging-roads symposium. University of Idaho, Moscow, ID. pp. 6-10.

Winter elk (Cervus elaphus) counts in the Pete King Creek drainage of north-central Idaho declined from 408 in 1957 to 63 in 1974. A study of the winter range indicated that elk numbers had decreased at a faster rate than forage had. Circumstantial evidence linked the accelerated elk decline to overharvest by hunters and the shifting of animals to different winter ranges. Causes were related to the construction of logging roads and the increased access they provided. (Author's abstract)

Leege, T.A. 1984. Guidelines for evaluating and managing summer elk habitat in northern Idaho. Wildlife Bulletin No. 11, Idaho Department of Fish and Game. 38 pp.

This document provides information on seasonal habitat preferences and food habits of elk during spring, summer and fall months in northern Idaho. Recommendations are made for coordinating logging, road buiding and livestock grazing with elk habitat preferences. An evaluation procedure is provided for estimating the effects of proposed land management activities on the quality of elk habitat. Computations take into consideration such things as quality, quantity and distribution of cover, forage, and security areas; and the density of open roads and livestock. Information for this document came from research literature and from numerous resource specialists in northern Idaho and adjacent areas.

Lyon, L.J. 1979. Habitat effectiveness for elk as influenced by roads and cover. Journal of Forestry (October), pp. 658-660.

Pellet counts conducted over an eight-year period confirmed that elk in western Montana tend to avoid habitat adjacent to open forest roads. The area avoided increases where the density of tree cover is low. Forest roads open to traffic cause available habitat to be less than fully effective. A method for determining the losses of effective habitat is presented. (Author's abstract)

Lyon, L.J. 1980a. Coordinating forestry and elk management. Transactions of the 45th North American Wildlife and Natural Resources Conference. Wildlife Management Institute, Washington, D.C. pp. 278-287.

This paper briefly summarizes the information from 10 years of research in the Montana cooperative elk logging study. It discusses the individual studies that made up the cooperative study, details components of the studies and then lists recommendations to mitigate or reduce the impacts of the components. Examples are road design, management, and area closures, timber harvesting and road construction.

Lyon, L.J. (Chairman). 1980. Montana cooperative elk-logging study. Annual Progress Report, U.S.D.A. Forest Service, Forestry Sciences Lab., Missoula, MT. 84 pp.

Progress report contains management recommendations for road locations and closures. In addition it gives a detailed progress report for the Long Tom and Chamberlain Creek elk-logging studies.

Lyon, L.J. (Chairman). 1981. Montana cooperative elk-logging study. Annual Progress Report, U.S.D.A. Forest Service, Forestry Sciences Lab., Missoula, MT. 90 pp.

Detailed progress reports are given for the abstracted studies shown below. In addition management recommendations are given.